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Hydrology and Earth System Sciences Discussions

Interactive comment on "A method to determine plant water source using transpired water" *by* L. B. Menchaca et al.

Anonymous Referee #1

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This HESSD paper provides results from experiments using plastic bags placed over leaves to capture transpired water. The authors point out that determining the isotopic composition of plant water, whether in leaves, or in isotopically unfractionated xylem water, requires destructive sampling, and it is also can be a laborious process. The samples collected are a mixture of the water the plant is using directly from xylem transport and the pool of water in the leaves that becomes isotopically more enriched in heavy isotopes as a result of evaporation. The basis for the method proposed is to relate the isotopic composition of the water transpired to the local meteoric water line for ground and soil waters at the site.

One of the assumptions being made here is that the isotopic composition of the water transpired by plants is a simple mixture of unfractionated xylem water and water un-

dergoing evaporative isotopic enrichment within a leaf in a consistent way. If that is the case, it should be valid to extrapolate back to the local meteoric water line from a separate leaf water evaporation line and determine the source point (on the local meteoric water line) of the isotopically unfractionated source water for the plant. The estimated source waters that are projected for each of the plants are not unreasonable, but as a generalization that can be depended upon, not all leaf evaporation lines extrapolate back to reasonable or known source waters. For example, Allison et al. 1985, Chemical Geology (Isotope Geoscience Section) 58: 145-156 show this lack of apparent source waters for Helianthus and Amaranthus grown in a glasshouse where the irrigation water was known. They concluded that treating leaf water evaporation lines for oxygen and hydrogen isotopes might be more practically understood as loci of individual steady state conditions reflecting varying humidities. These apparent evaporation lines do not necessarily intersect the meteoric source waters unless source waters and atmospheric water vapor are in isotopic equilibrium. This might have been the case in these experiments where bags were placed over leaves, but it is unfortunate that parallel comparative experiments were not accomplished using more standard destructive water extraction methods.

The lack of any comparison to other methods is clearly one of the weaknesses of the paper. It would be more convincing if similar results were obtained from distillation of xylem water samples from the sampled plants and the extrapolations of xylem water made from the transpired water collected here. Of course simply putting a bag over a leaf has a direct impact on transpiration by changing humidity and stomatal conductance with the observed feedbacks on heavy isotopic enrichment in the leaf. As the authors observe, the heavy isotope content of the transpired water declines over time and approaches the local meteoric water line.

It is not clear from the text when all of the experiments were accomplished, although Figure 2 indicates the stable isotope collections for pine were made in 1995. The results may be still timely, but the dated nature of the paper as written is apparent in the

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references. Only one stable isotope paper that was written within the past decade, a review paper, is cited in the references and it is not a particularly insightful review with respect to the topics discussed here. I was saddened to read in the acknowledgments of the recent death of the second author, but I have to infer that this manuscript may have been at least partially completed some years ago. The paper should be brought up to date with more references to the recent literature, as a much greater understanding of water source use by plants has been acquired in the past decade. The lack of clarity as to when the experiments were accomplished also should be rectified. Tap water isotopic composition in Berkeley is given but the abstract states that these plants were not irrigated, so I'm not sure there is any reason to give the isotopic composition of local tap water, which is brought in from high altitudes snowmelt in the Sierra, and thus significantly different. However, given the dry Mediterranean climate, is it absolutely certain that ground water or vadose zone water is not possibly impacted by recharge from irrigation? It is surprising to me that the vadose zone waters are reported to be isotopically lighter than ground waters. Given evaporative enrichment in soils and particularly considering the apparent summer sampling time frame, I would expect the opposite, i.e. soil waters would be relatively enriched in heavy isotopes relative to ground water. The authors conclude that the French broom taps water sources in the vadose zone relative to the eucalyptus tree tapping deeper ground water, but the differences are small, on the order of 1 per mille. It almost seems like common sense that the shrub would tap water in the soil above that tapped by the tree, and the authors point out that the differences in d18O values are not significant.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 863, 2007.